



USACO 2022 US OPEN CONTEST, GOLD PROBLEM 3. BALANCING A TREE

[Return to Problem List](#)

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English (en) ▾

Farmer John has conducted an extensive study of the evolution of different cow breeds. The result is a rooted tree with N ($2 \leq N \leq 10^5$) nodes labeled $1 \dots N$, each node corresponding to a cow breed. For each $i \in [2, N]$, the parent of node i is node p_i ($1 \leq p_i < i$), meaning that breed i evolved from breed p_i . A node j is called an ancestor of node i if $j = p_i$ or j is an ancestor of p_i .

Every node i in the tree is associated with a breed having an integer number of spots s_i . The "imbalance" of the tree is defined to be the maximum of $|s_i - s_j|$ over all pairs of nodes (i, j) such that j is an ancestor of i .

Farmer John doesn't know the exact value of s_i for each breed, but he knows lower and upper bounds on these values. Your job is to assign an integer value of $s_i \in [l_i, r_i]$ ($0 \leq l_i \leq r_i \leq 10^9$) to each node such that the imbalance of the tree is minimized.

INPUT FORMAT (input arrives from the terminal / stdin):

The first line contains T ($1 \leq T \leq 10$), the number of independent test cases to be solved, and an integer $B \in \{0, 1\}$.

Each test case starts with a line containing N , followed by $N - 1$ integers p_2, p_3, \dots, p_N .

The next N lines each contain two integers l_i and r_i .

It is guaranteed that the sum of N over all test cases does not exceed 10^5 .

OUTPUT FORMAT (print output to the terminal / stdout):

For each test case, output one or two lines, depending on the value of B .

The first line for each test case should contain the minimum imbalance.

If $B = 1$, then print an additional line with N space-separated integers s_1, s_2, \dots, s_N containing an assignment of spots that achieves the above imbalance. Any valid assignment will be accepted.

SAMPLE INPUT:

```
3 0
3
1 1
0 100
1 1
6 7
5
1 2 3 4
6 6
1 6
1 6
1 6
5 5
3
1 1
0 10
0 1
9 10
```

SAMPLE OUTPUT:

```
3
```

1
4

For the first test case, the minimum imbalance is 3. One way to achieve imbalance 3 is to set $[s_1, s_2, s_3] = [4, 1, 7]$.

SAMPLE INPUT:

```
3 1
3
1 1
0 100
1 1
6 7
5
1 2 3 4
6 6
1 6
1 6
1 6
5 5
3
1 1
0 10
0 1
9 10
```

SAMPLE OUTPUT:

```
3
3 1 6
1
6 5 5 5 5
4
5 1 9
```

This input is the same as the first one aside from the value of B . Another way to achieve imbalance 3 is to set $[s_1, s_2, s_3] = [3, 1, 6]$.

SCORING:

- Test cases 3-4 satisfy $l_i = r_i$ for all i .
- Test cases 5-6 satisfy $p_i = i - 1$ for all i .
- Test cases 7-16 satisfy no additional constraints.

Within each subtask, the first half of the test cases will satisfy $B = 0$, and the rest will satisfy $B = 1$.

Problem credits: Andrew Wang

Contest has ended. No further submissions allowed.